

ON MARINE TRIASSIC LAMELLIBRANCHS DISCOVERED IN THE MALAY PENINSULA.

By R. BULLEN NEWTON, F.G.S., etc.

Read 11th May, 1900.

PLATE XII.

RATHER more than two years ago Mr. H. F. Bellamy, C.E., of the Public Works Department, Straits Settlements, presented to the Geological Department of the British Museum some blocks of a light-coloured sandstone containing casts and impressions of lamellibranch shells, which he obtained from the Pahang Trunk Road on the Lipis River, situated in the Malay Peninsula.

The material is of unique interest from the fact that, so far as can be ascertained, no fossils have hitherto been recorded from this particular part of south-eastern Asia. Among the forms capable of identification is *Myophoria*, which occurs abundantly throughout the sandstone. The genus is intimately associated with *Trigonia* and *Schizodus*; the former ranging from Triassic times to the present day,¹ the latter from the Carboniferous to the close of the Permian period. From a stratigraphical point of view the occurrence of *Myophoria* is of great value, since it belongs exclusively to the Trias. On account of the prevalence of members of this genus in the rock in question, the term *Myophorian Sandstone* may well be bestowed on it.

The sandstone is generally of a light fawn-colour, extremely soft in places and easily scraped away; but other samples are of much harder character and closer texture, and moreover present a reddish-tinged appearance, with a burnt aspect suggesting original close proximity to igneous rocks. Many of the shell remains are merely moulds, although retaining, very perfectly, characteristic sculpture and form, as clearly shown by wax impressions. It is remarkable that the remains of Lamellibranchs alone are observable, no trace of any other organisms having as yet been detected. The full list of specimens identified comprises the following:—*Chlamys Valoniensis*, *Pleurophorus elongatus?*, *Pteria Pahangensis* (n.sp.), *Mytilus* cf. *minutus*, *Gervillia inflata*, *Pteroperna Malayensis* (n.sp.), *Myophoria Malayensis* (n.sp.), *M. ornata*, *M. inæquicostata*, *Myophoria* sp.?, *Actinodesma Bellamyi* (n.sp.). One of the most important of these is *Chlamys Valoniensis*, which has a wide geographical distribution and is

¹ The genus *Trigonia* has been generally considered to date from the Lias, but Dr. A. Bittner and Professor Wöhrmann, in support of D'Orbigny's views of 1849 ("Prodrome Paléontologie," vol. i, p. 198), both regard the Triassic form of *Lyriodon Gaytani*, Klipstein, as a true *Trigonia*; vide "Lamellibranchiaten der Alpenen Trias," Abhandl. k.k. geol. Reichs. (Wien), Bd. xviii (1895), pt. 1, p. 89, pl. x, figs 16-18.

characteristic of the Rhætic or uppermost Trias. It is to this horizon, therefore, that the Myophorian Sandstone from the Malay Peninsula must be referred.

DESCRIPTIONS OF THE SHELLS.

1. *CHLAMYS VALONIENSIS* (Defrance), Leymerie. Pl. XII, Fig. 1.

Pecten Valoniensis, Defrance: in De Caumont's "Sur quelques terrains de la Normandie Occidentale," Mem. Soc. Linn. Calvados¹ (Caen), vol. ii (1825), p. 507, pl. xxii, fig. 6 (imperfectly figured and without description). Leymerie: Mém. Soc. géol. France, vol. iii (1838), pt. 1, pp. 346 & 347, pl. xxiv, fig. 6. Portlock: Geol. Report Londonderry, 1843, p. 127, pl. xxv A, figs. 14, 15. Moore: Quart. Journ. Geol. Soc., vol. xvii (1861), p. 501; op. cit., vol. xviii (1862), pl. xvi, fig. 6. Stoliezka: Mem. Geol. Surv. India, vol. v (1865), pt. 1, pp. 44, 75. Griesbach: Records Geol. Surv. India, vol. xiii (1880), p. 95.

According to Leymerie, this shell is characterized by the presence of smaller ribs, disposed irregularly between the larger ones; by its transversely striated ribs; and by its ears being ornamented with vertical lines. The specimen referred to this species appears to be an internal impression of a right valve, showing an excellent contour, although part of the ventral margin is absent. It is covered with numerous radial costæ with faint indications of fine concentric striæ, some smaller intermittent ribs being also traceable. The auricles, of unequal size, are distinctly ornamented with thin vertical striations.

Dimensions.—Height 65, length 55 mm.

The species is here recognized under the genus *Chlamys*, Bolten, on account of its radially sculptured surface, valves of nearly equal size and convexity, and possessing a well-marked byssal orifice.

Distribution.—Characteristic of the Rhætic division of the Triassic series of England, Ireland, Europe, India, etc.; it occurs also in the Lower Lias (Calcaire de Valognes-Hottangian Beds) of Normandy, etc.

2. *PTERIA PAHANGENSIS*, n.sp. Pl. XII, Figs. 3, 4, 5.

Three internal casts of left valves, belonging apparently to the same species, are here referred provisionally to the genus *Pteria*²

¹ This reference has been wrongly quoted by some authors as "Ann. Soc. Linn. Normandie."

² It may be here pointed out that Klein's name of *Avicula*, 1753, being pre-Linnean, is not admissible, although adopted by Bruguière in 1792, Scopoli having founded his genus *Pteria* in 1777 (Introduct. Hist. Nat., p. 397) on the same type, viz. *Mytilus hirundo*, Linnaeus. Gray adopted this rendering in 1847, and replaced the family name of Aviculidæ by Pteriadæ (Proc. Zool. Soc., 1847, p. 199), a plan which has since been followed by Meek in 1876, and by Dr. Dall at the present day (see Eastman's edition of Zittel's "Text-Book of Palæontology," 1900, p. 370).

(= *Arricula*), but might probably be more correctly regarded under *Pterinea*, on account of their rectilinear contour, both the anterior and posterior sides being nearly vertical. The dorsal region is bounded by a straight hinge-line, which is produced posteriorly, whilst the body of the shell is convex and oblique. A rounded anterior aliform prolongation is present, the posterior area constituting a normal expansion, which is excavated at the margin. Surface with indication of concentric striæ of growth. These specimens are related to *Arricula*, sp. ? of Escher von Linth (Geol. Bemerk. Vorarlberg, 1853, p. 1, pl. iv, fig. 32), from the Muschelkalk of the Austrian Tyrol, but differ in possessing an extended posterior angle.

Dimensions.—Height 20, length 22 mm. (= Fig. 4).

3. *GERVILLIA INFLATA*, Schafhäütl. Pl. XII, Fig. 6.

Gervillia inflata, Schafhäütl: Geog. Unters. Südbayerischen Alpengeb., 1851, pp. 134, 145, pl. xxii, fig. 30. Gümbel: Geologie von Bayern, vol. i (1886), p. 695, woodcut fig. 6.

A very perfect mould of a left valve of this species has been injured in the umbonal region during the process of reduction, through the friable nature of the sandstone. Fortunately, before the accident an excellent wax impression was taken, giving very clearly all the details of the shell. It may be referred undoubtedly to this species, as interpreted by Gümbel's figure quoted above. The body of the shell is oblique, tumid, and elongate, with a short rounded anterior auricle. The hinge-line is straight and below the umbonal region, whilst the posterior expansion is moderately excavated on the outer margin. A series of concentric growth-lines ornament the surface.

Dimensions.—Height (from anterior expansion to extreme ventral edge) 50, length (from posterior wing extremity to anterior margin of auricle) 37 mm.

Distribution.—This species is characteristic of the Rhætic (Kossenbeds) of the Alps, etc.

4. *PTEROPERNA MALAYENSIS*, n.sp. Pl. XII, Fig. 7.

This is represented by a natural mould of a left valve, from which a good impression has been produced in wax. The specimen indicates an ovately oblique, convex, and narrow shell, with a very short and rounded anterior wing. The hinge is straight and moderately long, situated below the umbonal region of the shell, and supports a prominent aliform expansion. The posterior side of the body of the shell is elevated and abrupt. The surface shows strong concentric growth-lines. The specimen appears to be a new form, for which the above name is proposed, probably related to some of the Lower Oolite species of this genus described by Morris & Lycett, Deslongchamps, etc.

Pteroperma was established by Morris & Lycett in 1853 for *Gervillia costatula*, Deslongchamps, and other Jurassic species, which show affinities with the older genus *Pterinea* and the more modern *Pteria*.

Dimensions.—Height (taken from anterior expansion to ventral end) 38, length (hinge direction) 32 mm.

5. *ACTINODESMA BELLAMYI*, n.sp. Pl. XII, Fig. 2.

This species is represented by a single internal cast of a right valve, showing faint traces of the scar of the adductor muscle on the posterior side. Unfortunately the convex surface has been removed, so that little more than a marginal outline of the shell is preserved. It exhibits, however, the elongate, pointed, aliform extensions characteristic of *Actinodesma*, with indications of a median umbo. The hinge-line is straight, and shows certain irregularities which probably represent the position of the ligamental fossettes, whilst the body of the shell is oblong, slightly oblique, and highest on the byssal or anterior side. The genus founded by Sandberger (Verstein. Rheinischen Schicht. Nassau, 1850-1856, pp. 282 & 283, pl. xxix, fig. 17; type = *A. malleiforme*, Sandberger) is closely related to *Pterinea*, and correctly regarded by some authors as including *Glyptodesma* and *Ectenodesma* of Hall; it is typical of the Devonian period, and has apparently not previously been recorded from any higher horizon.

The specimen is named after its discoverer, Mr. H. F. Bellamy.

Dimensions.—Height 33, length of hinge 41 mm.

6. *PLEUROPHORUS ELONGATUS?*, MOORE. Pl. XII, Fig. 8.

Pleurophorus elongatus, Moore: Quart. Journ. Geol. Soc., vol. xvii (1861), p. 503; op. cit., vol. xviii (1862), pl. xv, figs. 14, 15.

Two well-developed casts of left valves occurring together appear to belong either to this species, or to be closely related thereto. They exhibit a strong ridge crossing the valve from the umbo to the ventral end, having above a depressed dorso-posterior angulated area. Anteriorly there is evidence of a well-developed adductor scar, with traces of an unbroken pallial line leading from it, slightly above and parallel to the ventral margin.

Dimensions.—Height 15, length 40 mm.

Distribution.—This species has been described by Moore from Beer-Crowcombe, near Ilminster, where it occurs in Rhætic deposits.

7. *MYTILUS*, allied to *M. MINUTUS*, Goldfuss. Pl. XII, Fig. 17.

An internal cast of a right valve which, on account of the probable terminal umbo, may be regarded as a *Mytilus*. It represents a depressed form with an oblique angulated hinge area bearing indications of a ligamental groove; the opposite or anterior margin is vertical, steep, and slightly excavated beneath the umbo. The form is probably closely related to *Mytilus minutus*, Goldfuss (Petref. Germaniæ, vol. ii, 1837, p. 173, pl. cxxx, fig. 6), from the Trias (Rhætic) of Germany and other localities.

Dimensions.—Height 26, length 13 mm.

8. MYOPHORIA ORNATA, Münster. Pl. XII, Figs. 12, 13, 14.

Myophoria ornata, Münster: Beitr. Petref.-Kunde südöstlichen Tirol., 1841, p. 88, pl. viii, fig. 21.

Cardita elegans, Klipstein: Beitr. geol. Kennt. östlichen Alpen, 1843, p. 255, pl. xvi, fig. 21.

Myophoria ornata, Bittner: Lamellibranch. Alpenen Trias, 1895, p. 93, pl. xii, figs. 20-22.

Some of the wax impressions yield fairly good fragmentary examples of *Myophoria ornata*. These exhibit a series of rather curved radial costæ, ornamented with closely set and strong transverse ridges, the longitudinal grooves being more finely striated in a similar direction. The species is of more or less elongate form, although no perfect examples are present.

Distribution.—Found in the St. Cassian Beds (Upper Trias) of the Tyrol, etc.

9. MYOPHORIA INÆQUICOSTATA, Klipstein. Pl. XII, Figs. 9, 10.

Myophoria ? inæquicostata, Klipstein: Beitr. geol. Kennt. östlichen Alpen, 1843, p. 254, pl. xvi, fig. 18.

Myophoria Whateleyæ, Buch: F. R. von Hauer, Sitzber. math.-nat. Cl. k. Akad. Wissensch. Wien., Bd. xxiv (1857), p. 554, pl. v, figs. 8-10, non figs. 4-7. (*Non* Von Buch.)

Myophoria inæquicostata, Alberti: Ueberblick über die Trias, 1864, p. 114, pl. ii, fig. 5. Bittner: Abhandl. k.k. geol. Reichs., Bd. xviii (1895), pt. 1, p. 94, pl. xi, figs. 1-14.

This form is related to *M. ornata*, but has costæ of unequal size, with frequently a smaller rib intervening between the larger ones. The sculpture, however, is very similar in the two species. The principal ribs are rounded, elevated, and covered with closely set annulations, the intermediate rib being finely beaded.

Distribution.—Upper Trias of St. Cassian, Raibl, etc.

10. MYOPHORIA MALAYENSIS, n.sp. Pl. XII, Fig. 15.

Some wax impressions of casts of this genus exhibit a form showing rather thin and elevated radial costæ, with an occasional intermediate smaller one, but apparently smooth and without ornamentation such as occurs in the other species referred to. Its affinities are unknown to the author, and it is probably a new species, for which the name of *M. Malayensis* may be proposed. Another smooth form, related to this species, is represented in Fig. 11.

Dimensions.—Height 15, length 13 mm.

11. MYOPHORIA, sp. Pl. XII, Fig. 16.

One specimen, represented by a cast, may belong to one of the foregoing species. It has about six prominent ribs, separated by

